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“The Right to Information, The Right to Live”

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Jawaharlal Nehru

“Step Out From the Old to the New”

IS 10793 (1983): Classification of defects in metallic fusion welds with explanations [MTD 11: Welding General]

“ज्ञान से एक नये भारत का निर्माण”

Satyanareshwar Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartṛhari—Nītiśākām

“Knowledge is such a treasure which cannot be stolen”



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Indian Standard**CLASSIFICATION OF IMPERFECTIONS IN METALLIC FUSION WELDS, WITH EXPLANATIONS**

(ISO Title: Classification of Imperfections in Metallic Fusion Welds, with Explanations)

National Foreword

This Indian Standard, which is identical with ISO 6520-1982 'Classification of imperfections in metallic fusion welds, with explanations', issued by the International Organization for Standardization (ISO), was adopted by the Indian Standards Institution on the recommendation of the Welding General Sectional Committee and approved by the Structural and Metals Division Council.

Wherever the words 'International Standard' appear, referring to this standard, they should be taken as 'Indian Standard'.

Additional Information

ISO 6520-1982 is a bilingual edition in English and French. As this Indian Standard is the national implementation of ISO 6520-1982, only English text has been reproduced. If the French text is required, reference should be made to the original ISO publication. As col 5 of the International Standard giving explanation in French has been deleted in the adopted standard, the col 6 dealing with illustrations of the International Standard has been renumbered as col 5 in the adopted standard.

Foreword

In this International Standard, imperfections are classified into the following six groups:

- 1 — Cracks*
- 2 — Cavities
- 3 — Solid inclusions
- 4 — Lack of fusion and penetration
- 5 — Imperfect shape
- 6 — Miscellaneous imperfections not included in the groups above.

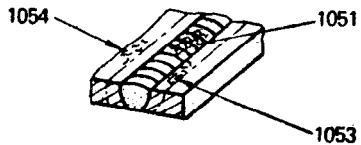
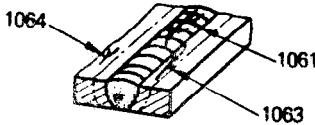
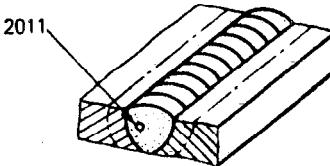
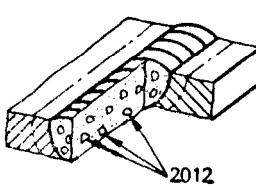
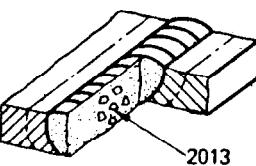
As regards the tables it has to be noted that:

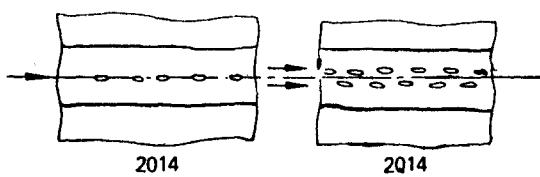
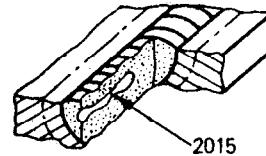
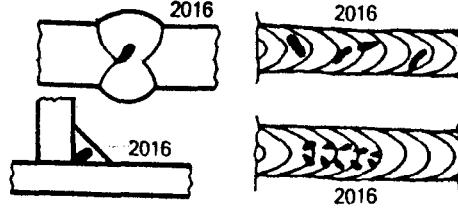
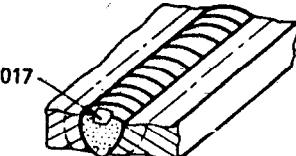
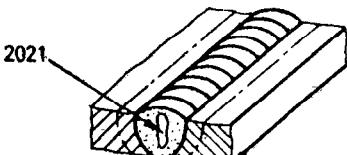
- a) column 1 gives a three figure reference number for each principal imperfection and a four figure reference number for sub-terms;
- b) column 2 gives the letter designation for imperfections at present used in the Collections of Reference Radiographs of the IIW (International Institute of Welding);
- c) column 3 gives the designation or name of each imperfection in English and in French;
- d) column 4 gives the explanation in English;—
- e) column 5 gives the explanation in French†;
- f) illustrations are provided where necessary to supplement the explanations.

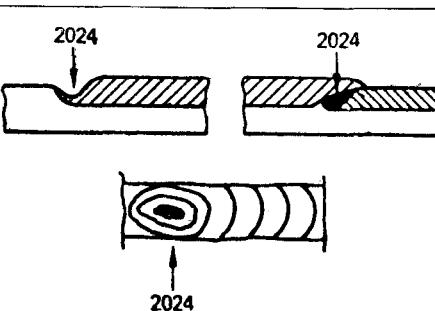
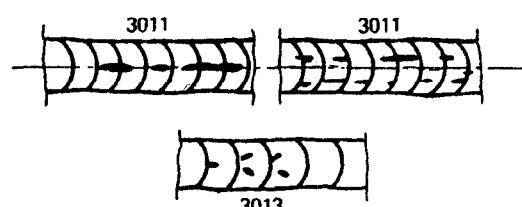
*The numbering of certain cracks is different from the initial proposal developed by the International Institute of Welding (IIW) (see explanations given in the annex).

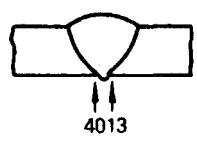
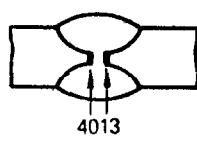
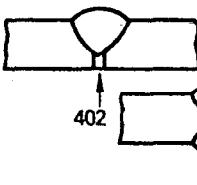
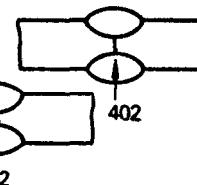
†(See Additional Information).

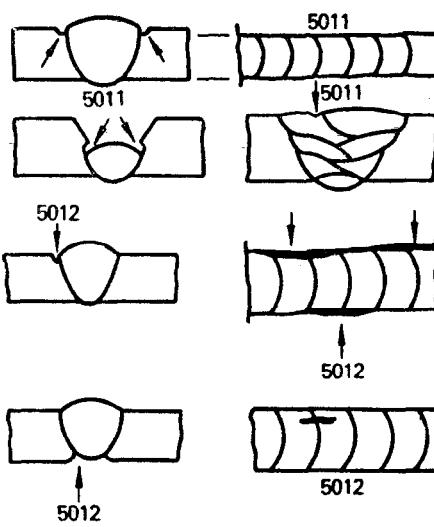
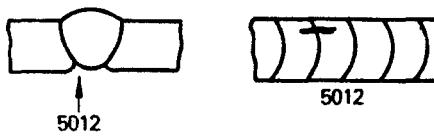
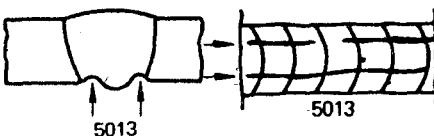
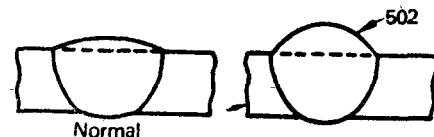
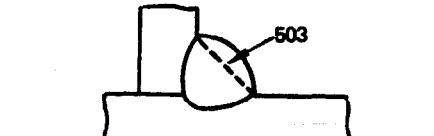
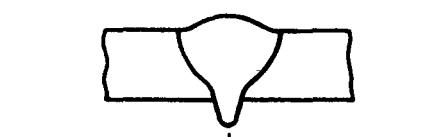
References IIW Reference Radiographs No.		Designation	Explanations	Illustrations
1	2	3	4	5
Group No. 1 CRACKS				
100	E	Cracks	A discontinuity produced by a local rupture which may arise from the effect of cooling or stresses.	
1001		Microfissure (micro-crack)	When a crack has microscopic dimensions it is known as a microfissure or micro-crack.	
101	Ea	Longitudinal crack	A crack substantially parallel to the axis of the weld. It may be situated: <ul style="list-style-type: none"> — in the weld metal, — at the weld junction, — in the heat-affected zone, — in the parent metal. 	
1011 1012 1013 1014				
102	Eb	Transverse crack	A crack substantially transverse to the axis of the weld. It may be situated: <ul style="list-style-type: none"> — in the weld metal, — in the heat-affected zone, — in the parent metal. 	
1021 1023 1024				
103	E	Radiating cracks	Cracks radiating from a common point. They may be found: <ul style="list-style-type: none"> — in the weld metal, — in the heat-affected zone, — in the parent metal. <p>Note — Small cracks of this type are known as star cracks.</p>	
1031 1033 1034				
104	Ec	Crater crack	A crack in the end crater of a weld which may be: <ul style="list-style-type: none"> — longitudinal, — transverse, — star cracking. 	
1045 1046 1047				

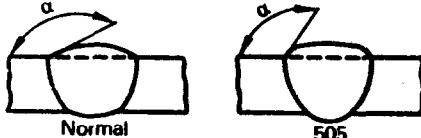
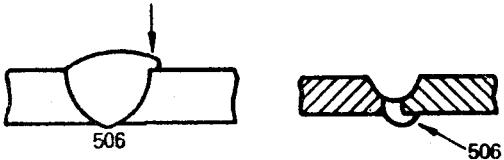
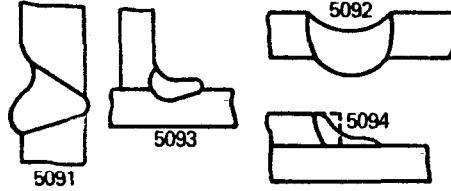
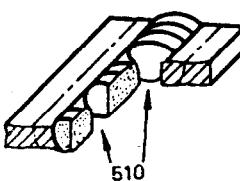
References IIW Reference Radiographs No.		Designation	Explanations	Illustrations
1	2	3	4	5
105	E	Group of disconnected cracks	<p>A group of disconnected cracks which may be situated:</p> <ul style="list-style-type: none"> — in the weld metal, — in the heat-affected zone, — in the parent metal. 	
1051 1053 1054				
106	E	Branching cracks	<p>A group of connected cracks originating from a common crack and distinguishable from disconnected cracks (105) and from radiating cracks (103). They may be situated:</p> <ul style="list-style-type: none"> — in the weld metal, — in the heat-affected zone, — in the parent metal. 	
1061 1063 1064				
Group No. 2 CAVITIES				
200 201	A	Gas cavity	A cavity formed by entrapped gas.	
2011	Aa	Gas pore	A gas cavity of essentially spherical form.	
2012		Uniformly distributed porosity	A number of gas pores distributed in a substantially uniform manner throughout the weld metal; not to be confused with linear porosity (2014).	
2013		Localized (clustered) porosity	Group of gas cavities.	

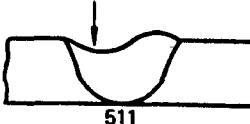
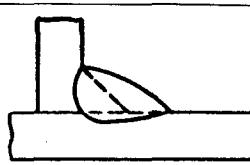
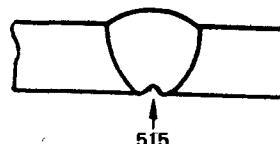
References IIW Reference Radiographs No.		Designation	Explanations	Illustrations
1	2	3	4	5
2014		Linear porosity	A line of gas pores situated parallel to the axis of the weld.	
2015	Ab	Elongated cavity	A large non-spherical cavity with its major dimension approximately parallel to the axis of the weld.	
2016	Ab	Worm-hole	A tubular cavity in weld metal caused by release of gas. The shape and position of worm-holes is determined by the mode of solidification and the sources of the gas. Generally they are grouped in clusters and distributed in a herring-bone formation.	
2017		Surface pore	A small gas pore which breaks the surface of a weld.	
202	K	Shrinkage cavity	A cavity due to shrinkage during solidification.	
2021		Interdendritic shrinkage	An elongated shrinkage cavity formed between dendrites during cooling which may contain entrapped gas. Such a defect is generally to be found perpendicular to the weld face.	
2022		Micro-shrinkage	Shrinkage only visible under the microscope.	

References IIW Reference Radiographs No.		Designation	Explanations	Illustrations
1	2	3	4	5
2023		Interdendritic micro- shrinkage	Interdendritic shrinkage only visible under the microscope.	
2024	K	Crater pipe	The depression at the end of a weld run and not eliminated before or during subsequent weld passes.	
300		Solid inclu- sion	<p>Group No. 3</p> <p>SOLID INCLUSIONS</p> <p>Solid foreign sub- stances entrapped in the weld metal.</p>	
301	Ba	Slag inclu- sion	<p>Slag entrapped in the weld metal. According to the circumstances of their formation, such inclusions may be:</p> <ul style="list-style-type: none"> — linear, — isolated, — others. 	
302	G	Flux inclusion	<p>Flux entrapped in the weld metal. According to circumstances such inclusions may be:</p> <ul style="list-style-type: none"> — linear, — isolated, — others. 	See 3011-3013
3021				
3022				
3023				
303	J	Oxide inclu- sion	Metallic oxide trapped in the weld metal during solidification.	

References IIW Reference Radiographs No.		Designation	Explanations	Illustrations
1	2	3	4	5
3031		Puckering	In certain cases, especially in aluminium alloys, gross oxide film enfoldment can occur due to a combination of unsatisfactory protection from atmospheric contamination and turbulence in the weld pool.	
304	H	Metallic inclusion	A particle of foreign metal trapped in the weld metal. It may be of : — tungsten, — copper, — other metal.	
3041 3042 3043				
400		Lack of fusion (incomplete fusion)	<p>Group No. 4</p> <p>LACK OF FUSION AND PENETRATION</p> <p>Lack of union between weld metal and parent metal or weld metal and weld metal. It will be one of the following:</p> <ul style="list-style-type: none"> — lack of side wall fusion, — lack of inter-run fusion¹, — lack of fusion at the root of the weld. <p>¹ In certain countries one uses the terms 'collage noir' and 'collage blanc' depending on the presence or absence of oxide inclusions together with the lack of fusion.</p>	   
401				
4011				
4012				
4013				
402	D	Lack of penetration (incomplete penetration)	Lack of fusion between parent metal and parent metal due to failure of weld metal to extend into the root of the joint.	  

References IW Reference Radiographs No.		Designation	Explanations	Illustrations
1	2	3	4	5
500		Imperfect shape	Group No. 5 IMPERFECT SHAPE Imperfect shape of the external surfaces of the weld or defective joint geometry.	
5011	F	Undercut	A groove at the toe(s) (or at the root) of a weld run due to welding. Undercut may be continuous (term 5011) or intermittent (term 5012) but in English such a distinction is not normally made.	
5012	F	Undercut		
5013		Shrinkage groove	A shallow groove in the root caused by contraction in the weld metal along each side of the penetration bead (see also 515).	
502		Excess weld metal	An excess of weld metal at the face(s) of the butt weld.	
503		Excessive convexity	An excess of weld metal at the face of a fillet weld.	
504		Excessive penetration	Excess weld metal protruding through the root of a weld made from one side or through weld metal previously deposited from either side of a multi-run joint.	

References IIW Reference Radiographs No.		Designation	Explanations	Illustrations
1	2	3	4	5
5041		Local protrusion	Local excessive penetration.	
505		Incorrect weld profile	Too small an angle (α) between the plane of the parent metal surface and a plane tangential to the weld bead surface at the toe.	
506		Overlap	Excess of weld metal at the toe of a weld covering the parent metal surface but not fused to it.	
507		Linear misalignment	Misalignment between two welded pieces such that whilst their surface planes are parallel they are not at the required level.	
508		Angular misalignment	Misalignment between two welded pieces such that their surface planes are not parallel (or at the intended angle).	
509		Sagging	Weld metal collapse due to gravity. According to the circumstances it may be: <ul style="list-style-type: none"> — sagging in horizontal-vertical, — sagging in flat or overhead, — sagging in a fillet weld, — sagging (melting) of the edge. 	
510		Burn through	A collapse of the weld pool resulting in a hole in the weld or at the side of the weld.	

References IIW Reference Radiographs No.		Designation	Explanations	Illustrations
1	2	3	4	5
511		Incompletely filled groove	A longitudinal continuous or intermittent channel in the surface of a weld due to insufficient deposition of weld metal.	
512		Excessive asymmetry of fillet weld	Explanations not necessary.	
513		Irregular width	Excessive variation in width.	
514		Irregular surface	Excessive surface roughness.	
515		Root concavity	A shallow groove due to shrinkage of a butt weld at the root (see also 5013).	
516		Root porosity	Spongy formation at the root of a weld due to bubbling of the weld metal at the moment of solidification.	
517		Poor restart	A local surface irregularity at a weld restart.	
Group No. 6		MISCELLANEOUS IMPERFECTIONS		
600		Miscellaneous imperfections	All imperfections which cannot be included in groups 1—5.	

References IIW Reference Radiographs No.		Designation	Explanations	Illustration
1	2	3	4	5
601		Stray flash or arc strike	Local damage to the surface of the parent metal adjacent to weld, resulting from arcing or striking the arc outside the weld groove.	
602		Spatter	Globules of weld metal or filler expelled during welding and adhering to the surface of parent metal or solidified weld metal.	
6021		Tungsten spatter	Particles of tungsten transferred from the electrode to the surface of parent metal or solidified weld metal.	
603		Torn surface	Surface damage to the removal by fracture of temporary welded attachments.	
604		Grinding mark	Local damage due to grinding.	
605		Chipping mark	Local damage due to use of a chisel or other tools.	
606		Underflushing	Reduction in thickness of metal due to excessive grinding.	

A N N E X

CRACK NUMBERING

A-1. This annex is intended:

- for one part, to avoid confusion between the two numbering systems regarding the level of interpretation;
- for the other part, to permit users of the IIW numbering system already being applied to have a transition period in which to conform with the numbering system defined in this International Standard.

A-2. The number references of various types of crack are given mostly in respect of their location, these being in the weld metal, at the weld junction, in the heat-affected zone or in the parent metal, so it was decided to identify systematically identical locations by the same last digit.

Examples

- longitudinal crack (in the parent metal) : 1014
- transverse crack (in the parent metal) : 1024

This has resulted in the following modifications to the initial number references for defects in group 1 as proposed by the IIW :

IIW Proposal	References Adopted by ISO
1011	1011
1012	1012
1013	1013
1014	1014
1021	1021
1022	1023
1023	1024
1031	1031
1032	1033
1033	1034
1041	1045
1042	1046
1043	1047
1051	1051
1052	1053
1053	1054
1061	1061
1062	1063
1063	1064